Citation:

Wang L, Manson JE, Buring JE, Sesso HD. Meat intake and the risk of hypertension in middle-aged and older women. *J Hypertens.* 2008 Feb; 26(2): 215-222.

PubMed ID: 18192834

Study Design:

Prospective cohort study

Class:

B - Click here for explanation of classification scheme.

Research Design and Implementation Rating:

POSITIVE: See Research Design and Implementation Criteria Checklist below.

Research Purpose:

To investigate the association of total red meat, types of red meat and poultry intake with the incidence of hypertension (HTN) over ten years of follow-up in a large cohort of middle-aged and older US women.

Inclusion Criteria:

Female US health professionals 45 years of age and older, free from cardiovascular disease (CVD) and cancer (except nonmelanoma skin cancer).

Exclusion Criteria:

- Insufficient completion of the food-frequency questionnaire (FFQ) (more than 70 items left blank), implausible mean energy intake (less than 600 or 3,500kcal or more per day), insufficient data on red meat or poultry intake and women with pre-randomization CVD that was reported post-randomization
- Women with baseline HTN (self-reported physician diagnosis of HTN, systolic blood pressure (SBP) 140mmHg or more, diastolic blood pressure (DBP) 90mmHg or more or current or past treatment for HTN.

Description of Study Protocol:

Recruitment

The study cohort is part of the Women's Health Study, a randomized, double-blind, placebo-controlled two-by-two factorial trial evaluating the risks and benefits of low-dose aspirin and vitamin E in the primary prevention of CVD.

Design

Prospective cohort.

Dietary Intake/Dietary Assessment Methodology

- Semi-quantitative FFQ: Participants were asked how often they had consumed a specific portion of each type of food, on average, during the previous year to calculate the average daily intake for each food item
- Baseline red meat and poultry intake were assessed from a 131-item validated semi-quantitative FFQ. Total red meat (including unprocessed and processed red meat), total poultry and individual red meat items were considered.

Blinding Used

Original cohort was blinded.

Statistical Analysis

- Incidence rates of HTN were calculated and compared across quintiles of red meat or poultry intake
- Cox regression models were used to estimate the relative risk of HTN across quintiles of red meat or poultry intake, with the lowest quintile as the reference category
- Relative risks were also calculated to evaluate the individual effect of specific nutrients in meat products, including saturated fat, animal protein, cholesterol and heme iron
- Linear trends across increasing categories of intake were tested using the median value of each intake category as an ordinal variable.

Data Collection Summary:

Timing of Measurements

- Hypertension was assessed at baseline and with annual follow-up questionnaires
- Food intake and other covariates were assessed at baseline.

Dependent Variables

Incident HTN defined as at least one of four criteria from the yearly follow-up questionnaires:

- Self-reports of a new physician diagnosis of HTN
- Self-reports of newly initiated anti-hypertensive treatment
- Self-reported SBP 140mmHg or more
- Self-reported DBP 90mmHg or more.

Independent Variables

- Total red meat intake: Beef or lamb as a main dish; pork as a main dish; beef, pork or lamb as a sandwich or mixed dish; hamburger, hotdogs, bacon and other processed meats such as sausage, salami and bologna
- Unprocessed red meat: Beef, lamb, or pork as a main dish, in a sandwich or as a mixed dish, and hamburger
- Processed red meat: Hotdogs, bacon and other processed meat
- Total poultry intake: Chicken and turkey.

Control Variables

- Age
- Race
- Total energy intake
- Randomized treatment assignment
- Smoking
- Alcohol use
- Exercise
- Menopausal status
- Post-menopausal hormone use
- Multivitamin use
- Family history of myocardial infarction (MI)
- Body mass index (BMI)
- History of diabetes and hypercholesterolemia
- Intake of fruits and vegetables, whole grains and dairy products.

Description of Actual Data Sample:

- *Initial N:* 39,310 (completed a FFQ)
- *Attrition (final N):* 28,766 (after applying exclusions)
- *Age:* 53.8 years
- *Ethnicity:* White, non-Hispanic
- *Other relevant demographics:* US health professionals
- *Location:* US.

Summary of Results:

Key Findings

- During 10 years of follow-up, 8,693 incident cases of HTN were identified
- Compared with women in the lowest quintile of red meat intake (after adjusting for demographic characteristics, lifestyle factors, clinical factors, and intake of other foods), women in the fifth quintile had a risk ratio for HTN of 1.13 (95% CI: 1.04 to 1.23, P=0.008)
- Compared with women who consumed no red meat, those consuming more than zero to less than 0.05, 0.5 to less than 1.0, 1.0 to less than 1.5, and 1.5 or more servings per day had multivariate risk ratios (95% CI) of HTN of 1.24 (1.08 to 1.43), 1.25 (1.08 to 1.44), 1.32 (1.13 to 1.53), and 1.35 (1.14 to 1.59), respectively (P=0.008)
- The positive association between intake of red meat and HTN was moderately strong, dose-related and independent of known hypertension risk factors. The association was also stronger for women with optimal baseline blood pressure
- There was no association between poultry intake and the risk of HTN
- Comparing women who consumed more than one serving a week of a specific red meat product with those who consumed no red meat, the multivariateRRs of HTN were 1.33 for hot dogs; 1.27 for bacon; 1.26 for other processed red meats; 1.31 for beef or lamb as main dish; 1.22 for pork as main dish; 1.28 for beef, pork, or lamb as sandwich or mixed dish; and 1.27 for hamburgers (all P<0.05).

Other Findings

- Red meat intake was weakly, though significantly, correlated with baseline SBP (Spearman R=0.08, P<0.0001) and DBP (R=0.07, P<0.0001)
- Poultry intake was also weakly, but significantly correlated with baseline SBP (R=0.01) and DBP (R=0.02).

Author Conclusion:

A higher intake of red meat, including both unprocessed and processed red meat, was associated with an increased risk of HTN in middle-aged and older women.

Reviewer Comments:

Study Strengths

- *High follow-up rates, a large number of incident cases and comprehensive covariate information*
- *Valid and reliable FFQ for estimating long-term intake of red meat and poultry.*

Study Limitations

- *Self-reported HTN status (but this outcome has previously been shown to have high validity among health professionals)*
- *A single baseline measurement of red meat and poultry intake.*

Research Design and Implementation Criteria Checklist: Primary Research

Relevance Questions

1.	Would implementing the studied intervention or procedure (if found successful) result in improved outcomes for the patients/clients/population group? (Not Applicable for some epidemiological studies)	N/A
2.	Did the authors study an outcome (dependent variable) or topic that the patients/clients/population group would care about?	Yes
3.	Is the focus of the intervention or procedure (independent variable) or topic of study a common issue of concern to nutrition or dietetics practice?	Yes
4.	Is the intervention or procedure feasible? (NA for some epidemiological studies)	N/A

Validity Questions

1.	**Was the research question clearly stated?**	Yes
1.1.	Was (were) the specific intervention(s) or procedure(s) [independent variable(s)] identified?	Yes

1.2.	Was (were) the outcome(s) [dependent variable(s)] clearly indicated?	Yes
1.3.	Were the target population and setting specified?	Yes
2.	**Was the selection of study subjects/patients free from bias?**	Yes
2.1.	Were inclusion/exclusion criteria specified (e.g., risk, point in disease progression, diagnostic or prognosis criteria), and with sufficient detail and without omitting criteria critical to the study?	Yes
2.2.	Were criteria applied equally to all study groups?	Yes
2.3.	Were health, demographics, and other characteristics of subjects described?	Yes
2.4.	Were the subjects/patients a representative sample of the relevant population?	???
3.	**Were study groups comparable?**	Yes
3.1.	Was the method of assigning subjects/patients to groups described and unbiased? (Method of randomization identified if RCT)	N/A
3.2.	Were distribution of disease status, prognostic factors, and other factors (e.g., demographics) similar across study groups at baseline?	N/A
3.3.	Were concurrent controls used? (Concurrent preferred over historical controls.)	N/A
3.4.	If cohort study or cross-sectional study, were groups comparable on important confounding factors and/or were preexisting differences accounted for by using appropriate adjustments in statistical analysis?	Yes
3.5.	If case control or cross-sectional study, were potential confounding factors comparable for cases and controls? (If case series or trial with subjects serving as own control, this criterion is not applicable. Criterion may not be applicable in some cross-sectional studies.)	N/A
3.6.	If diagnostic test, was there an independent blind comparison with an appropriate reference standard (e.g., "gold standard")?	N/A
4.	**Was method of handling withdrawals described?**	Yes
4.1.	Were follow-up methods described and the same for all groups?	Yes
4.2.	Was the number, characteristics of withdrawals (i.e., dropouts, lost to follow up, attrition rate) and/or response rate (cross-sectional studies) described for each group? (Follow up goal for a strong study is 80%.)	N/A
4.3.	Were all enrolled subjects/patients (in the original sample) accounted for?	N/A
4.4.	Were reasons for withdrawals similar across groups?	N/A

4.5.	If diagnostic test, was decision to perform reference test not dependent on results of test under study?	N/A
5.	**Was blinding used to prevent introduction of bias?**	Yes
5.1.	In intervention study, were subjects, clinicians/practitioners, and investigators blinded to treatment group, as appropriate?	N/A
5.2.	Were data collectors blinded for outcomes assessment? (If outcome is measured using an objective test, such as a lab value, this criterion is assumed to be met.)	Yes
5.3.	In cohort study or cross-sectional study, were measurements of outcomes and risk factors blinded?	N/A
5.4.	In case control study, was case definition explicit and case ascertainment not influenced by exposure status?	N/A
5.5.	In diagnostic study, were test results blinded to patient history and other test results?	N/A
6.	**Were intervention/therapeutic regimens/exposure factor or procedure and any comparison(s) described in detail? Were interveningfactors described?**	Yes
6.1.	In RCT or other intervention trial, were protocols described for all regimens studied?	N/A
6.2.	In observational study, were interventions, study settings, and clinicians/provider described?	Yes
6.3.	Was the intensity and duration of the intervention or exposure factor sufficient to produce a meaningful effect?	Yes
6.4.	Was the amount of exposure and, if relevant, subject/patient compliance measured?	Yes
6.5.	Were co-interventions (e.g., ancillary treatments, other therapies) described?	N/A
6.6.	Were extra or unplanned treatments described?	N/A
6.7.	Was the information for 6.4, 6.5, and 6.6 assessed the same way for all groups?	Yes
6.8.	In diagnostic study, were details of test administration and replication sufficient?	N/A
7.	**Were outcomes clearly defined and the measurements valid and reliable?**	Yes
7.1.	Were primary and secondary endpoints described and relevant to the question?	Yes
7.2.	Were nutrition measures appropriate to question and outcomes of concern?	Yes
7.3.	Was the period of follow-up long enough for important outcome(s) to occur?	Yes
7.4.	Were the observations and measurements based on standard, valid, and reliable data collection instruments/tests/procedures?	Yes

7.5.	Was the measurement of effect at an appropriate level of precision?	Yes
7.6.	Were other factors accounted for (measured) that could affect outcomes?	Yes
7.7.	Were the measurements conducted consistently across groups?	Yes
8.	**Was the statistical analysis appropriate for the study design and type of outcome indicators?**	Yes
8.1.	Were statistical analyses adequately described and the results reported appropriately?	Yes
8.2.	Were correct statistical tests used and assumptions of test not violated?	Yes
8.3.	Were statistics reported with levels of significance and/or confidence intervals?	Yes
8.4.	Was "intent to treat" analysis of outcomes done (and as appropriate, was there an analysis of outcomes for those maximally exposed or a dose-response analysis)?	N/A
8.5.	Were adequate adjustments made for effects of confounding factors that might have affected the outcomes (e.g., multivariate analyses)?	Yes
8.6.	Was clinical significance as well as statistical significance reported?	???
8.7.	If negative findings, was a power calculation reported to address type 2 error?	N/A
9.	**Are conclusions supported by results with biases and limitations taken into consideration?**	Yes
9.1.	Is there a discussion of findings?	Yes
9.2.	Are biases and study limitations identified and discussed?	Yes
10.	**Is bias due to study's funding or sponsorship unlikely?**	Yes
10.1.	Were sources of funding and investigators' affiliations described?	Yes
10.2.	Was the study free from apparent conflict of interest?	Yes